WHAT IS CLAIMED IS:

1. A system for computing a network code, comprising:

computing flows between at least one sender and two or more receivers; and

computing network code coefficients restricted to the computed flows.

2. The system of claim 1 wherein the network code coefficients include:

encoding vectors for each interior network node, including a sender; and

decoding matrices for each receiver.

3. The system of claim 2 wherein the elements of the encoding vectors and decoding matrices are elements of a finite field whose size does not depend on the rate of the computed flows.

4. A system for transmitting symbols from at least one sender to two or more receivers via a plurality of interior network nodes, comprising:

restricting the symbols to flows between the at least one sender and the two or more receivers;

encoding at each interior network node the symbols entering the node into symbols exiting the node; and

decoding at each receiver the symbols entering the receiver.

5. The system of claim 4 wherein the encoding and decoding are linear operations.

6. The system of claim 5 wherein the linear operations are over a finite field whose size is independent of the rate of the computed flows.

7. A system for computing a network code, comprising:

computing linear combination coefficients for each of at least one interior network node of a network, said nodes including a sender;

computing representation vectors for symbols exiting each interior network node from representation vectors for symbols entering each node and the linear combination coefficients; and

computing decoding matrices for each of at least one receiver of the network from the representation vectors for the symbols entering each receiver.

8. The system of claim 7 further comprising setting encoding vectors for each interior node, including the sender, to the linear combination coefficients.

9. The system of claim 7 wherein computing the linear combination coefficients further includes ensuring that the representation vectors for the symbols transmitted across edges on a cut between the sender and each receiver are full rank.

10. A computer-implemented process for computing efficient network codes for a multicast network, comprising using a computing device to:

receive known parameters defining a multicast network, which includes a plurality of internal network nodes, including at least one sender, and two or more receivers;

compute flows between the sender and the two or more receivers using the known parameters; and

compute encoding vectors for each internal network node, including the at least one sender, wherein encoding vector coefficients are restricted to the computed flows; and

compute decoding matrices for each receiver.

11. The computer-implemented process of claim 10 wherein computing efficient network codes for a multicast network includes an initialization stage comprising:

reducing the multicast network to a network with edges between internal nodes having unit capacities by replacing each edge having a capacity c with c edges having unit capacity.

12. The computer-implemented process of claim 11, wherein the initialization stage further comprises:

a determination of whether each edge having unit capacity is within the computed flows; and

ordering any edges within the computed flows topologically from the sender to the two or more receivers.

13. The computer-implemented process of claim 12 wherein the topologically ordered edges are used for computing the encoding vectors.

14. The computer-implemented process of claim 12 wherein the topologically ordered edges are used for computing the decoding matrices for each receiver.

15. The computer-implemented process of claim 10 wherein the network parameters include:

a network layout;

a flow capacity of each internal node in the network, including flow capacities of the at least one sender and the two or more receivers.

16. A computer-implemented process for computing a network code for a network including at least one sender, a plurality of internal nodes and at least one receiver, comprising using a computing device to:

compute linear combination coefficients for each interior network node and the at least one sender;

compute representation vectors for symbols exiting each interior network node from representation vectors for symbols entering each interior network node and the computed linear combination coefficients; and

compute decoding matrices for each receiver from the representation vectors for the symbols entering each receiver.

17. The computer-implemented process of claim 16 further comprising designating the linear combination coefficients as encoding vectors for each interior node and the at least one sender.

18. The computer-implemented process of claim 16 wherein computing the linear combination coefficients further includes ensuring that the representation vectors for symbols transmitted across edges on a cut between the sender and each receiver are full rank.

19. A method for constructing multicast network codes, comprising:

inputting a network layout defined by:

two or more receivers,

a plurality of internal network nodes with at least one edge between each node, said nodes including a sender, and

a flow capacity of each edge;

computing flows from the network layout between the sender and the two or more receivers;

computing network codes for each internal network node, including the sender, from the computed flows, said network codes comprising encoding vectors for encoding one or more symbols for multicast transmission from the sender through the network to the two or more receivers; and

computing decoding matrices for each receiver for decoding each encoded symbol multicast to each receiver.

20. The method of claim 19 wherein computing flows from the network layout between the sender and the two or more receivers includes an initialization stage comprising:

reducing the network layout by replacing each edge having a capacity *c* with *c* edges having unit capacity; and

determining whether each edge having unit capacity is within the computed flows.

21. The method of claim 20 wherein the initialization stage further comprises ordering any edges determined to be within the computed flows topologically from the sender to the two or more receivers.

22. The method of claim 21 wherein the topologically ordered edges are used for computing the decoding matrices for each receiver for decoding each encoded symbol multicast to each receiver.